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ABSTRACT

High ability, highly verbal fifth grade students (n=12) were studied, by employing think aloud protocols, to identify students' use of learning strategies, encoding processes, and navigational decisions in a hypermedia lesson on propaganda techniques. Subjects were asked to read and think aloud as they worked their way through the concept lesson and immediate posttest. These "think alouds" were transcribed and coded for analysis. Results revealed a wide variation in amount and type of learning strategies used by students with high, average, and low test scores. Navigational decisions and encoding processes also varied widely among the students. High test scorers (n=4) tended to use more varied learning strategies and were more consistent in their navigation decisions than the other two groups. The high group used a combination of strategies: comprehension monitoring, elaboration, and rehearsal. The low test scoring group (n=5) used some of the same strategies, but used them to a lesser degree and with more errors or faulty construction. The average group (n=3) tended to use a greater combination of strategies than the other two groups.(Contains 28 references.) (Author/SWC)

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Children's Learning Strategies, Encoding Processes, and Navigational Decisions in a Hypermedia Concept Lesson

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Abstract

High ability, highly verbal fifth grade students were the selected subjects for this study. The purpose of the study was to identify students' use of learning strategies, encoding process, and navigational decisions in a hypermedia lesson on propaganda techniques by employing think aloud protocols. Subjects were asked to read and think aloud as they worked their way through the concept lesson and immediate posttest. These think alouds were transcribed and coded for analysis. Results revealed a wide variation in amount and type of learning strategies used by students with high, average, and low test scores. Navigational decisions and encoding processes also varied widely among these groups of students. Noted that high test scores tended to use more and more varied learning strategies as well as being more consistent in their navigation decisions than the other two groups. The low test scoring group tended to use the encoding process of construction than did the other two groups; but with more errors or faulty construction.

Introduction

In recent years there have been amazing technological advances in the means for delivering instruction, such as multimedia and hypermedia programs. These advances allow educators to create more learner control over the instruction and has been widely touted that this flexibility is desirable (Duffy & Jonassen, 1992). However, such mediums lack structure and/or have ill-structured domains (Spiro, Feltovich, Jacobson, & Coulson, 1992). Thus, learners can become lost in these environments (Davidson-Shivers, Rasmussen, & Bratton-Jeffery, in press; Lin & Davidson, in press; Kerr, 1987; Shin, 1992).

Students' success or failure in learning performance in such environments may be dependent on their ability to activate relevant strategies and monitor their own learning. Learning strategies are those mental techniques which provide for organizing, rehearsing and elaborating on knowledge as well as tactics for coping with motivation and affect (Mayer & Weinstein, 1986). The techniques can be expanded if metacognitive strategies, such as cognitive monitoring, are incorporated. Metacognitive strategies allow students to maintain self- awareness and control of their information processing when learning.

There also seems to be a pervasive assumption among developers and educators that students often know how to manage their own learning in these environments (Davidson-, et al, 1996; Glaser, 1984; Federico, 1984). It has been found that effective learners can spontaneously generate and use specific strategies when interacting with traditional instructional materials (Anderson, 1980; Rohwer, 1980). However, Battig (1979), among others (Jones, 1987; Davidson, 1988), states that there is wide variation in learners' abilities to generate and use learning strategies. In reality, not all learners are sophisticated in their learning strategy generation and use. In fact, research has shown (although often ignored) that students make poor choices in determining what is best for them within a given instructional environment (Clark, 1984; Cronbach & Snow, 1977). This may be especially true within hypermedia in which navigation adds an additional level of complexity. Davidson and associates (1995) found that middle school students who used complex learning strategies of cognitive monitoring, elaboration in combination with rehearsal strategies did better than those students who indicated that they were only using rehearsal strategies. Successful performance in the hypermedia lesson was also based on more strategies being used and in greater variety by these students.

Related to these learning strategies are the navigational decisions for determining what part of the program to see, how much of the program to see, and when. Davidson and associates reported in that same study that students tended to seek additional items based on how well they believed they knew the new information. In most cases, these middle school age children tended to move through the program after two or less practices because they "thought they knew it." However, the treatment materials were a hierarchical-based structure in which students tended to select materials in the order by which they were presented. Based on the results of this preliminary study, it was posited that effective users of the hypermedia learning material employed appropriate strategies and decision

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making techniques. However, it is not necessarily clear what strategies would be employed by such students if the hypermedia lesson had another type of linking structure that was web-based.

Purpose of the Study

The primary purpose of this current investigation was to determine the various strategies that students employed in a hypermedia environment that had an associative structure (Lin & Davidson, in press; Jonassen, 1988). In order to discover the strategies that students employed, we decided once again to use a think aloud protocol method with high ability and high verbal students.

The purposes of this study were to identify:

Those learning strategies generated by the individual student in an associative-linked form of hypermedia environment.

The commonalties of heuristics generated by the students who performed successfully on the posttest.

The navigational decisions and points of departure (if any) that these students employed when moving through the various parts of the program.

Subjects

Subjects were 5th grade students (N = 12) from both public and private middle schools in the Mobile, Alabama area. This was a non-randomized pool of subjects due to the fact that the researchers asked teachers to select high ability, high verbal students to participate. It seemed reasonable to assume that these students would have acquired effective strategies for learning new information as well as communicate their thoughts than other students. All participation was voluntary and confidential.

Materials

The lesson, Propaganda Techniques, is a computer-based coordinate concept lesson which describes various categories of propaganda techniques used in advertising. The advertising screens were modeled after advertisements popular magazine and television ads. The original lesson was created by Carrier, Davidson, & Williams (1984). The current version was redesigned using HyperCard 2.1 software for use with the Macintosh LCs or PowerBooks. This newest version allowed students to select any of the four concepts and once within the program, they could select any example item, practice item, or definition. In addition, they could jump back to the submenu or the main menu on any given screen. Although not totally random, this associative linked structure allowed flexibility in amount seen and the order in which items were seen.

Procedures

Researchers were trained to monitor observations, to conduct interviews, and to encourage think alouds. Training occurred through written descriptions and articles on these qualitative methods, followed by discussion over the readings, and a demonstration of these techniques was modeled during a pilot test of the HyperCard stack.

Teachers at two schools were asked to suggest potential subjects who possessed high ability and high verbal. We sent out permission slips to all students matching this criteria and their parents. Written permission to participate in the study was obtained from seventeen students and their parents. We allotted two hours for each subject to complete the lesson, the test, and the interview. However, most subjects completed the lesson within an hour and a half. Subjects were scheduled on an individual basis to proceed through the lesson.

For each subject, experimenters explained the general purpose and procedure of the study. Subjects were told that information would be kept confidential, that they were to talk out loud as they went through the lesson. In turn, they would be videotaped as they proceeded through the lesson and that the tapes would be destroyed at a later date. The experimenters described the lesson and stated that the students would be tested over their knowledge of the concepts presented.

As each subject worked through the lesson, the qualitative procedure of "think alouds" (Flower & Hayes, 1981; Wedman & Smith, 1987, Davidson, et al, 1995) was used in order that subjects explain what they were thinking, how they were remembering, and why they were making the selections from one section of the program to another. If the individual fell silent for any length of time during the session, the experimenter would prompt them by asking questions such as "what are you thinking?", "why did you choose that?", or "how did you decide that?" As each student completed the program, his or her responses were video- and audio-taped. Experimenters observed students as they progressed through the lesson and made additional notations of navigation and/or use of strategies

such as counting on fingers, moving lips, and other body language cues. Each subject completed a sixteen-item test at the end of the lesson and were interviewed, which was also videotaped.

Data Analysis

Data considering generated strategies and their use were collected through the students' verbal reports made before, during, or after performing the instructional task (Gagne, 1985). The reports were collected through the use of video/audio tape recordings of each individual subject (n=12). Upon completion of the task the subjects were interviewed for retrospective reports about specific subjects' actions during the instruction.

The verbal reports were transcribed into written form (protocols) and examined for patterns of responses using a protocol analysis (Ericcson & Simon, 1984). Recorded data will be coded using a framework similar to that proposed by Weinstein and Mayer (1985). Each transcript was coded by two independent researchers, to ensure accurate coding of data. When discrepancies were encountered, they were resolved by the two coders. If they could not agree, a third researcher arbitrates and determines the appropriate code. Due to technical difficulties some video and audio tapes were unclear and could not be transcribed which reduced the number of students to twelve.

The framework suggested by Weinstein and Mayer (1986) included eight categories of learning strategies: basic rehearsal strategies, complex rehearsal strategies, basic elaboration strategies, complex elaboration strategies, basic organizational strategies, complex organizational strategies, comprehension monitoring strategies, and affective and motivational strategies. (See Table 1.) Processes for encoding were also coded: selection, acquisition, construction, and integration. To these codes, the following were added by the researchers (Davidson et al; 1995; 1996): experimentation effects (prompting, encouragement, design evaluation, directions, teaching, and clarification), student responses (clarification and evaluating design), and navigation decisions (confidence, curiosity, familiarity, avoidance, fun, order, practice, satisfaction, and unclear).

Table 1. Categories of Learning Strategies, Encoding Processes, and Experimentation Effects

Category	*Definition*
Learning Strategies	
Basic Rehearsal Strategies	repeating item names for remembering
Complex Rehearsal Strategies	copying, underlining, shadowing material
Basic Elaboration Strategies	forming mental images or sentences relating information
Complex Elaboration Strategies	paraphrasing, summarizing, or describing knowledge
Basic Organizational Strategies	grouping or ordering information
Complex Organizational Strategies	outlining, hierarchy development
Comprehension Monitoring Strategies	checking for comprehension failures or for understanding
Affective and Motivational Strategies	student behavior and attitudes: alert, relaxed, interested, positive
Encoding Processes	
Selection	attending to particular concepts presented
Selection Reading	attending to written information by reading aloud
Acquisition	transferring information from working memory to long-term memory
Construction	actively building connections between information reaching long-term memory
Integration	actively searching for prior knowledge in long-term memory, transferring to working memory, and building external connections

Navigation Decisions	
Confidence	expressed certainty of competence
Curiosity	sought further information; aroused interest
Familiarity	showed recognition of item or idea
Avoidance	steered away from area/item due to some negative association
Fun	expressed desire to be entertained; have fun
Order	decided based on some organizational pattern or to create an organizational pattern
Practice	decided to try another item
Satisfaction	stated positive feeling about accomplishments
Unclear	reason for choice could not be determined; either student could not provide or could not be interpreted
Experimentation Effects	influence of experimentation in amount of prompting, encouragement, evaluating design, providing directions, and teaching
Student Effects	asking for clarification and evaluating design of program

Adapted from Davidson et al (1995; 1996); Weinstein & Mayer (1986).

Upon completion of the coding process, the data was converted to text files and loaded into the software package HyperResearch (for either MAC version 1.56) which performs analysis on qualitative data. HyperResearch is designed to permit organization, storage, retrieval, and analysis of qualitative data (ResearchWare, 1991-1993). Studies using HyperResearch are structured by cases (individual units of study, in this research study, a case is one student) which are then comprised of source material.

Results and Conclusions

The preliminary study by Davidson and her associates (1995) identified a variety of patterns in strategies employed by individual student cases. For example, one participant always did two examples and then the test item; a second participant would work through any exercise in which she had right answers, once she made a wrong answer she went immediately to the test. Results also indicated that verbal learners were able to articulate their reasons for navigation selection and indicated that they preferred to proceed through a program linearly, if they knew in advance they were going to be tested. Reading and rehearsal were two of the most common strategies identified by observers/monitors as well as noted by students during interview. Based on interview data, it was found that a reliance on visual clues was also noted by many of the participants. These identified patterns will be further delineated at the presentations.

The following graphs show the frequencies and types of learning strategies, navigational decisions, and encoding processes for high (score of 13 and above), average (score of 11 or 12) and low (score of 10 and under) test scoring groups. (Recall that all students were selected on the basis of high ability, high verbal.) Figure 1 shows the averages and types of learning strategies for these three groups. This finding shows that even among high ability students there is a wide variation in use of learning strategies. The average group (n=3) tended to use a combination of comprehension monitoring, elaboration, rehearsal and affective strategies more than the other two groups. For the high group (n=4), their combination of strategies were comprehension monitoring, elaboration, and rehearsal. The low group had some of the same strategies, but used them to a lesser degree and with more errors. That is, their elaborations or monitoring of their understanding tended to be miscued and inaccurate. Of interest, is that the average group used more strategies in greater combination than did the other two groups. Perhaps the high group may have been more interested in efficiency of learning rather than exploration since they knew that they would be tested on the concepts.

Frequencies and Types of Learning Strategies for High, Average, and Low Groups

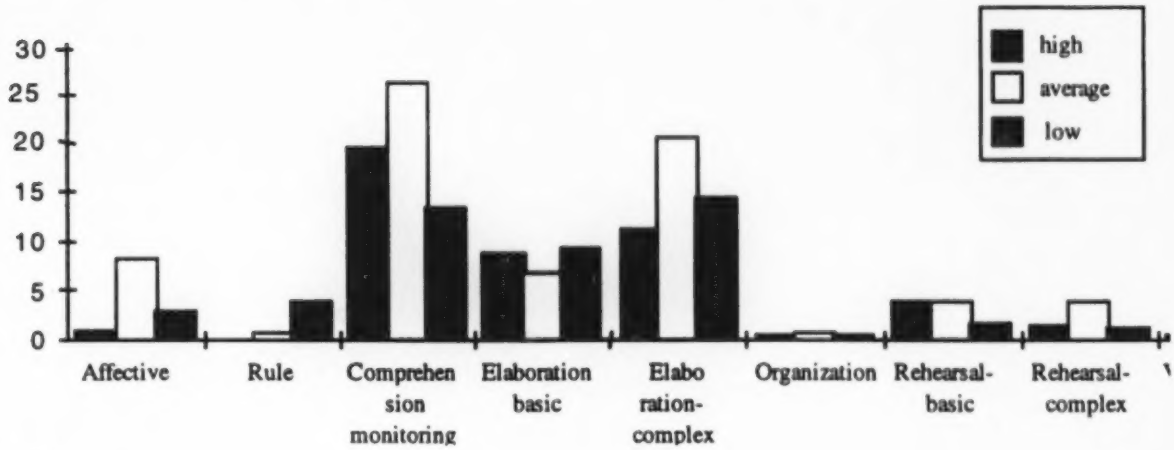

Figure 1

Figure 2 shows the frequencies and types of encoding processes employed by the same three groups. By far the greatest type of processing used was construction followed by selection. These experimenters suggest that construction refers to the process of someone taking information from working memory and transferring it to long term memory. Selection refers to concepts to which students paid particular attention while attending to the computer screen. While the low group tended to employ construction at a higher level than the other two groups, the experimenters noted during the lesson and in the protocols that the low group employed faulty construction by building concepts with flawed elements. The high group mainly processed the information at the higher levels of encoding processes, that of construction and integration. In fact, only the high posttest scoring group employed the integration level of encoding processes.

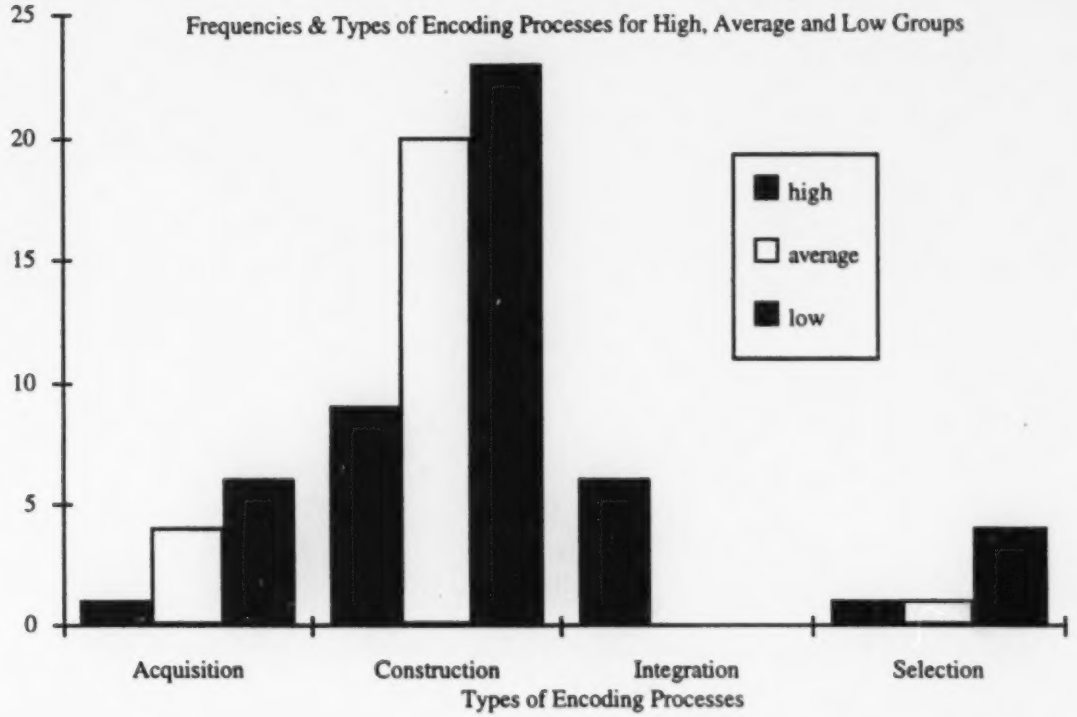

Figure 2

Figure 3 shows the frequencies and types of navigational decisions by the three groups. Again it can be noted that there is a wide variation in navigational decision patterns even among these high ability, highly verbal students, which may lead to their variation in posttest scores. The high group made their decisions based on confidence, order and practice. They were lowest in curiosity, familiarity, and fun. The decisions made by this group may suggest that these particular students were bent toward learning the concepts efficiently. The average group had similar navigation patterns in terms of confidence and practice but to a lesser degree than the high group. Conversely, the decisions made by this average group that were based on curiosity, familiarity, and fun are higher than the high group. The low group was lowest in confidence and practice, but higher in satisfaction than the other two groups. They also were highest in curiosity, familiarity, and fun. in comparison to the other two groups. The low group also made decisions based on order, but to a lesser degree than did the high group; however, experimenters observed that these decisions were less logical and were nonsensical than those in the other groups who navigated on the basis of order. Only the average and low groups made decisions based on avoidance. Overall, it appears that the more successful posttest performances were made when the learner based navigation on confidence, order and practice and less so if decisions were based on curiosity, familiarity, and fun.

Frequencies and Types of Navigational Decisions Used by High, Average, and Low Groups

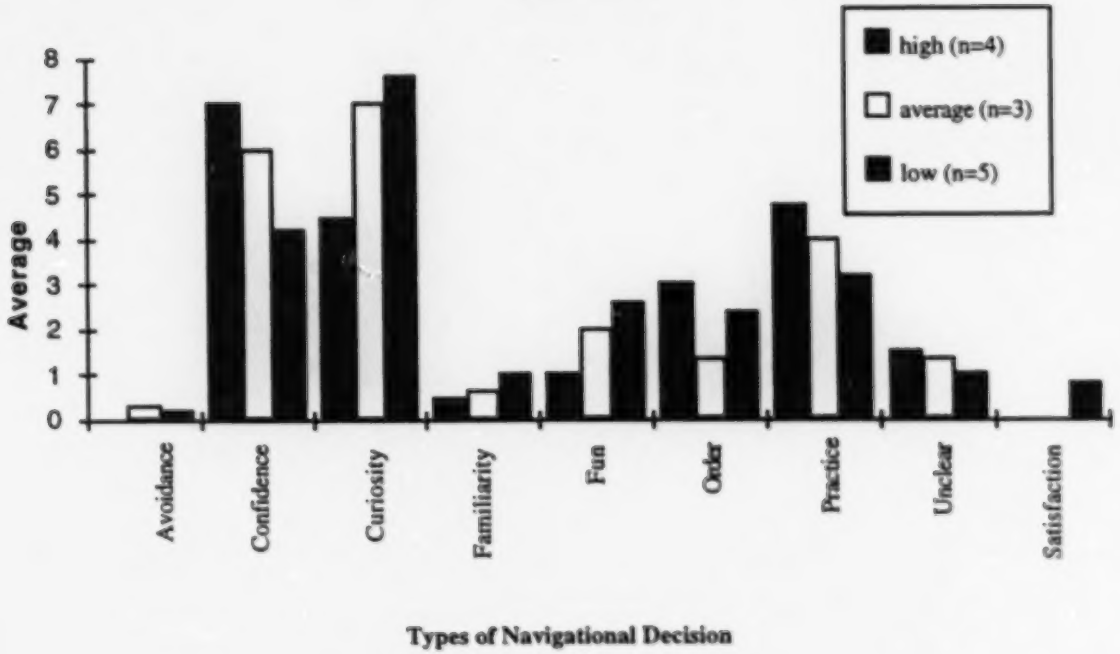

Figure 3

Based on observations in this current study, students tended to show a variety odf ways in what was selected and when. Rarely did students select the definitions, most selected a few examples and then moved to the practice items before preceding to the posttest. However, the choices varied as to which item was selected. In one case, a student selected only the practice items before going to the test. This particular subject never verified if he was correctly identifying the concept, instead he relied on the knowledge of results in making his choice. He was one of the lowest scoring on the posttest. In terms of navigation decisions, students successful in learning the concepts presented appeared to base their decisions on their understanding of the information as well as their level of confidence. These two navigational decisions mirror their use of those learning strategies.of comprehension monitoring and elaborations.

Post interviews that immediately followed the posttest and knowledge of score yielded some interesting information. Most of the subjects were familiar with computers through school and/or having them at home. However, no one stated that they had encountered such a game. When asked how well they like the lesson, the vast majority stated that they liked it; some wanted to purchase the program because they thought it was fun and they wanted to improve their scores. They also thougth the lesson and test were about the right length. Although not all of the students mastered the concepts presented, they did appear to enjoy it.

Significance

This study was specifically designed to examine the variations in strategies that students employ. Because qualitative methods were used in this study, further analysis of the protocols will be necessary to yield experment effects on learning performance as well as strategy use and navigational decisions. Future investigations will examine strategy use within additional types of hypermedia and structures. In addition , other student populations will need to be sampled in future investigations.Also the identificatiaon of students' thought processes with other types of learning ourtcomes may jprovide additional information to developers and users of multimedia/hypermedia..

Finally, it will be most important to determine how learners can be taught those learning strategies identified as effective for use in hypermedia environments. Learner control may become a viable option when we begin to understand which learner should have control, how much and what type of control should be given, and under what conditions should learner control exist. By determining effective strategies used and appropriate navigational decisions made in these various hypermedia environments, we can begin to understand how students be successful in learning performance. The significance of this work ultimately rests in further identification of effective strategies that have been generated and used and ultimately, in teaching these strategies to other students.

References

Anderson, T. J. (1980). Study strategies and adjunct aids. In F. J. Spiro, B. C. Bruce, & W. F. Brown (Eds.). *Theoretical Issues in Reading Comprehension.* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Battig, W. F. (1979). Are there important "individual differences" between or within individuals? *Journal of Research in Personality, 13,* 546-558.

Carrier, C. A., Davidson, B. V. & Williams, M. D. (1985). The selection of instructional options in a computer-base coordinate concept lesson. *Educational Communications & Technology Journal, 33,* 199-212.

Clark, R. E. (1984). Research on student though processes during computer-based instruction. *Journal of Instructional Development, 7,* 2-5.

Cronbach, L. J. & Snow, R. E. (1977). *Aptitudes and Instructional Methods.* New York, NY: Irvington Publishers, Inc.

Davidson, G. V. (1988, January). Training children to use learning strategies to improve their ability to attain concepts. Paper presented at the annual convention of the Association of Educational Communications and Technology, New Orleans, LA.

Davidson-Shivers, Rasmussen, K.L., & Bratton-Jeffery, F. (In Press). Investigating Learning Strategies Generation in a Hypermedia Environment Using Qualitative Methods. *Journal of Computing in Childhood Education.*

Davidson, G.V., Shorter, L., Crum, & Lane, J. (1996). Children's use of learning strategies and decision making in a hypertext computer lesson. *1996 Proceedings of the Ed Media World Conference.* June, 1996. Boston, MA.

Davidson, G. V., K. Rasmussen, & F. Bratton-Jeffery (1995, April). Investigating Learning Strategies Generation in a Hypertext Environment Using Qualitative Methods. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Davidson, G.V., F. Bratton-Jeffery, S. Hoffman, & K. Rasmussen. (1994, May). Determining successful generation & use of learning strategies among students in a hypertext computer-based environment. Presented at the University of South Alabama Research Forum, Mobile, AL.

Duffy, T.M. & Jonassen, D.H. (Ed.) (1992). *Constructivism and the technology of instruction: A conversation.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Ericcson, K. A. & Simon, H. A. (1984). *Protocol Analysis.* Cambridge, MA: MIT Press.

Federico, P. A. (1984). Adaptive instruction: Trends and issues. In R. E. Snow, P. A. Federico, & W. E. Montague (Eds.). *Aptitude, Learning and Interaction (Volume 1).* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Flower, L. & Hayes, J. (1981). The pregnant pause: An inquiry into the nature of planning. *Research in the Teaching of English, 16,* 229-243.

Gagne, E. D. (1985). *The Cognitive Psychology of School Learning.* Boston, MA: Little, Brown, and Company.

Glaser, R. (1984). Education and thinking. *American Psychologist, 39,* 93-104.

Goetzfried, L. & Hannafin, M. (1985, January). The effect of adaptive, advisement, and linear CAI control strategies on the learning of mathematics rules. Paper presented at the annual convention of the Association for Educational Communications and Technology, Anaheim, CA.

Jonassen, D. H. (1988). Designing structured hypertext and structuring access to hypertext. *Educational Technology, 28,* 13-16.

Jones, B. F. (1987). Quality and equality through cognitive instruction. *Educational Leadership, 43,* 4-12.

BEST COPY AVAILABLE

Kerr, S. T. (1987, February). Finding one's way in electronic space: The relative importance of navigational cues and mental models. Paper presented at the annual conference of the Association for Educational Communication and Technology.

Lin, C.H. & Davidson, G.V. (In press). Effects of linking structure and cognitive style on students' performance and attitude in a computer-based hypertext environment. *Journal of Computing Research in Education.*

Murphy, M. A. & Davidson, G. V. (1991). Computer-based adaptive instruction: Effects of learner control on concept learning. *Journal of Computer-Based Instruction, 18,* 51-56.

Ross, S. M. & Rakow, E. A. (1981). Learner control versus program control adaptive strategies for selection instructional support on math rules. *Journal of Educational Psychology, 73,* 745-753.

Shin, E. J. (1992). Effects of learner control, advisement, and prior knowledge on young students' learning in a hypertext environment. Unpublished doctoral dissertation, University of Texas at Austin, Austin, TX.

Shneiderman, B. & Kearsley, G. (1989). *Hypertext Hands On!.* Reading, MA: MIT Press.

Spiro, R.J., Feltovich, P.J., Jacobson, M.J., & Coulson, R.L. (1992) in Duffy, T.M. & Jonassen, D.H. *Constructivism and the technology of instruction: A Conversation.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Tennyson, R. D. (1981). Use of adaptive information for advisement in learning concepts and rules using computer-assisted instruction. *American Educational Research Journal, 18,* 425-438.

Wedman, J. F. & Smith, P. L. (1987). An examination of elaborated and hierarchically organized instruction. Paper presented at the meeting of the Association for Educational Communications and Technology, Atlanta, GA.